A REVIEW OF THE TIPULIDAE OF AUSTRALIA (DIPTERA). I.

Introduction; Historical; Distribution. Subfamily Tipulinae: Clytocosmus Skuse.

By Charles P. Alexander, Massachusetts State College, Amherst, Mass., U.S.A.

(Plate ii; four Text-figures.)

[Read 30th March, 1932.]

Introduction.

The crane-flies (family Tipulidae) are among the most generalized of all existing Dipterous insects. The family is particularly numerous in species in the Australian fauna, with approximately 550 valid described species (end of 1930), the great majority of which are from the mountainous sections of New South Wales, Victoria and Tasmania. This particular area must be considered as being fairly well known, although numerous additions to the list will be made as a result of further collecting at different seasons, at all possible stations, particularly in the mountains, and by investigation of hitherto neglected ecological habitats. Crane-flies are notable lovers of moisture and almost all are to be found in damp, shady places, as along woodland streams, among ferns in the gullies, around damp spots in low-lying pockets on mountain slopes, on the wet, vertical faces of cliffs, in and about the margins of sphagnum bogs, in helophytic associations having little or no shrubbery or tree growth, and, in fact, in a great variety of minor ecological societies where there is some amount of moisture. An excellent idea of the haunts of Victorian Tipulidae is given in the paper by Wilson (concerning crane-flies, *Vict. Nat.*, 46, 1929, 88–94). Some species of these flies are extremely local, occurring in certain restricted habitats while being entirely absent from other apparently suitable stations near by. Many of the smaller types are not in evidence during the hours of sunlight, lurking among the bases of close-growing sedges or rushes and becoming active only at sundown, then appearing in small dancing swarms during the hours of twilight or night. From the above statements it will become apparent that in any country, even in Europe and eastern North America, where the Tipulid fauna has been particularly well collected and studied, previously unknown species are still being discovered. Crane-flies occurring in the mountains are apt to be more limited in range than are coastal species, the more widely distributed of such mountain forms being found at low altitudes in Tasmania, at increasing heights in the Victorian and Australian Alps, while in the northern part of their range, as at Barrington Tops, they are found only at considerable altitudes (5,000 feet and higher).

The only monographic treatment of this group of flies for the Australian fauna is that by Skuse (1889–1890), a notable work that is rendered obsolete only by the great accession of new forms. A few groups of Diptera that were held to be Tipulidae by older workers and were so considered by Skuse have since been removed to separate families and since they have already been discussed by the

present writer will not be included in this series of papers. These isolated groups are the Tanyderidae and Trichoceridae, together with the subfamily Bruchomyiinae, now generally placed with the Psychodidae. The following papers consider the Australian species in these groups:

ALEXANDER, C. P., 1926.—The Trichoceridae of Australia. PROC. LINN. SOC. N.S.W., 51, 299-304, 11 figs.
————, 1928A.—The Australian species of the genus *Nemopalpus*. *Ibid.*, 53, 291-294, 2 figs.
————, 1928B.—The Tanyderidae of Australia (Diptera). *Ibid.*, 53, 367-374, 4 figs.
————, 1930.—Observations on the Dipterous family Tanyderidae. *Ibid.*, 55, 221-230, 2 Pl., 1 fig.

The only major group formerly held to fall within the limits of the family Tipulidae that has not been taken within the Australasian Region is the family Ptychopteridae, represented by two genera (*Bittacomorpha* and *Bittacomorphella*) in the Northern Hemisphere, and *Ptychoptera* with representatives in the Nearctic, Palaearctic, Oriental and Ethiopian Regions. The possibility is remote that members of this family will be found to occur in Australia.

The family Tipulidae as now restricted has three subfamilies, the Tipulinae, Cylindrotominae and Limoniinae, all of which are represented in Australia, the second by a single genus with two closely allied species. The subfamily Limoniinae, which includes almost all of the small and medium-sized Tipulidae, has five tribes—Limoniini, Lechriini, Pediciini, Hexatomini and Eriopterini—all of which are represented in the Australian fauna, the second and third by a single genus each, the others by a host of species distributed in many genera and subgenera. After due planning I have decided to attempt the present review of the Australian Tipulidae along the following lines:

The initial part will discuss briefly the historical development of the subject, the chief points in the facies of the fauna, and a table of all known genera and subgenera in Australia, showing their extra-limital distribution. The keys to the subfamilies will be followed in subsequent parts by keys to the tribes, genera and species, as the various groups fall under consideration in their proper sequence. Suitable illustrations of species will be provided and full references to all other such published figures given. The treatment of the individual species must necessarily be brief lest the papers assume unnecessary proportions. As now planned, and worked out in this part of the review for the genus *Clytocosmus*, it is intended only to give a brief diagnosis of the individual species, with particular emphasis on the critical points needed for separation from allied forms, followed by the detailed distribution as known, and any further pertinent observations concerning the species. Following such a plan, it is hoped that a serviceable treatment may result. It should be emphasized at the start that much work remains to be done, that in very many cases only fragmentary and insufficient materials are available, that in the majority of cases the seasonal and geographical distribution of any given species is little known, and, lastly, that the writer would greatly appreciate further co-operation in the nature of specimens for determination, records of distribution, notes on habits of adults, and any other data. The almost total lack of information on the early stages of Australian Tipulidae has been referred to by the author elsewhere and need not be discussed here.

The story of progress in our knowledge of these flies has been one of unselfish aid and co-operation on the part of almost all Australian Dipterologists, as well as many other collectors and interested persons. The more important sources

are here indicated, while others will be mentioned in the various subsequent parts.

Queensland: Collections made by T. L. Bancroft, L. Biró, the late W. H. Davidson, the Dodds, H. Hacker, G. H. Hardy, J. F. Illingworth, A. M. Lea, E. Mjöberg, F. A. Perkins, F. H. Roberts, F. H. Taylor and others.

New South Wales: By V. J. Robinson and W. Heron in Dorrigo and northward; and by the late E. W. Ferguson, W. W. Froggatt, G. Goldfinch, Ian Mackerras, A. J. Nicholson, R. J. Tillyard, A. L. Tonnoir and F. E. Wilson, in the Blue Mountains and Southern Alps.

Victoria: By C. Barrett, C. H. Borch, J. Clark, G. F. Hill, J. A. Kershaw, J. Searle, A. L. Tonnoir and F. E. Wilson, and by Miss Jean Galbraith and Mrs. Edith Coleman.

Tasmania: By H. J. Carter, G. H. Hardy, G. F. Hill, the late A. M. Lea, A. L. Tonnoir and G. Weindorfer.

South Australia: By the late A. M. Lea, F. E. Wilson and J. O. Wilson.

Western Australia: By J. Clark, the late E. W. Ferguson, W. H. Mathews and L. J. Newman.

The most extensive of these collections, including in each case in excess of one hundred specimens, are those of Dr. Illingworth and Mr. Taylor in Queensland; Mr. Heron, the late Mr. W. H. Davidson, the late Dr. E. W. Ferguson, Dr. Mackerras, Mr. Tonnoir and Mr. F. E. Wilson in New South Wales; the Tonnoir and Wilson collections in Victoria; and the Hardy and Tonnoir collections in Tasmania.

The outstanding collections of Australian Tipulidae in the Commonwealth are the following:

Queensland Museum, Brisbane.—A few types of species described by the writer (*Mem. Queensland Mus.*, 7, 1920, 52–63), as well as some further specimens taken by Hardy and Perkins.

Macleay Collection, University of Sydney.—Contains almost all of the Skuse collection, arranged in five large drawers, including all types of the 1889–1890 papers with twelve exceptions, indicated below. My information on the present state of this collection is based on enlarged photographs of the drawers taken by Mr. John Shewan through the kind interest of the Museum authorities. Drawer I includes all material in the tribe Limoniini, as now constituted, as well as *Leiponeura* (*Lipophleps*), now placed in the Eriopterini. Three species of Anisopodidae (as Rhyphidae) are also included. Drawer II includes the Eriopterini, beginning with *Amphineurus*, and the Hexatomini through the genus *Limnophila*. Drawer III includes the remainder of the Hexatomini, beginning with *Gynoplistia*; the Pediciini; and the beginning of the Tipulinae, including *Dolichopeza*, through *Ptilogyna*. Drawer IV continues the Tipulinae, from *Plusiomyia* to *Ischnotoma par*. Drawer V completes the collection, including the Tipulinae from *Ischnotoma rubriventris* through *Macromastix*. The collection is in a beautiful state of preservation. Through the kind interest of Dr. Ian Mackerras, the male hypopygia of *Molophilus* and *Tasiocera* were made into micromounts and were kindly sent to me for study, being then returned and placed on pins with the remainder of the insect. It is hoped that other species will be dealt with in the same way.

The Macleay Museum collection also includes (1) the types of the Tipulidae collected by the University Zoological Expedition to Barrington Tops in January, 1925, and described by the writer (These Proceedings, 53, 1928, 51–70); (2) the

types of species of *Molophilus* described by the writer from the Ferguson Collection; and (3) the type of Skuse's *Plusiomyia olliffi*.

Australian Museum, Sydney.—Includes the Tipulidae collected by Helms on Mt. Kosciusko and by Olliff in Victoria described by Skuse (1889–1890). The following types are included: *Dicranomyia helmsi*, *Geranomyia lutulenta*, *Amphineurus maculosus*, *Molophilus helmsi*, *M. montivagus*, *Gynoplistia viridithorax*, *Clytocosmus helmsi*, *Platyphasia princeps*, *Acracantha inornata*, *Limnophila imitatrix*, *Macromastix obscurirostris*, and *M. helmsi*. The type of *Teucholabis meridiana* is represented only by a microslide of a leg and a wing; as far as known the types of *Gynoplistia chalybeia* and *Dapanoptera richmondiana* are nonexistent. In this collection are also the types of twenty-two species (other than those of *Molophilus* mentioned above) described by the writer from the Ferguson Collection.

School of Public Health and Tropical Medicine, University of Sydney.—Types of the Taylor Collection described by the writer.

Collection of the Division of Economic Entomology, Canberra.—One of the largest collections of Australian Tipulidae, based primarily on the material taken by A. L. Tonnoir in New South Wales, Victoria, and Tasmania, including more than 100 holotype specimens.

National Museum, Melbourne.—A large general collection, including several types of species described by the writer, received through the kindly interest of Messrs. Clark and Kershaw.

F. Erasmus Wilson, Melbourne.—The largest collection of Victorian Tipulidae, also including many other notable specimens, especially a large series from the Blue Mountains, New South Wales; totals in excess of 100 holotype specimens.

South Australian Museum, Adelaide.—Includes some fifty types of species described by the writer (*Rec. S. Aus. Mus.*, 2, 1922, 223–270), received through the kindly interest of the late Mr. Arthur M. Lea.

A number of collections outside the Commonwealth possess a certain number of type-specimens. The more important of these are:

Alexander Collection, Amherst, Mass., U.S.A.—More than 50 types, based chiefly on material collected by Barrett, Davidson, Dodd, Hardy, Heron, Hill, Illingworth, Mathews, Robinson and others.

Hawaiian Sugar Planters' Collection, Bishop Museum, Honolulu.—A few species, taken by the late R. Helms.

British Museum (Natural History), London.—The Walker types, with a few others.

Hope Museum, Oxford.—The Westwood types.

Museum of Natural History, Paris.—The Guérin and Macquart types.

Riksmuseets, Stockholm.—A few species described from Mjöberg's collections, named by Alexander and Riedel.

Deutsches Entomologisches Museum, Berlin-Dahlem.—The type of *Clytocosmus lichtwardti* Riedel.

Natural History Museum, Vienna.—Types of Schiner.

Historical.

A brief historical summary of the development of our knowledge of the Tipulidae of Australia may be given. Of the more than 600 names that have been applied to species in this fauna, more than 550 species appear to be valid. These names have been bestowed by seventeen workers on the group. In the

accompanying summary I have listed the total names given by the individual authors, indicating which of these are valid species, synonyms and doubtful species. When further collecting is done and, especially, when certain doubtful type-specimens may be examined, these various figures will be slightly altered. Our subject may well be divided into three periods—1. The pre-Skusean; 2. The period of Skuse; and 3. The modern or post-Skusean phase of our knowledge of this subject.

1. *The pre-Skusean period.*

The first crane-fly to be described from Australia was the common and widely-distributed *Macromastix costalis*, named by Swederus in 1787. Two synonyms of this species represent the sole contributions of Erichson (1842) and Jaennicke (1867). Guérin (1830) erected the genus *Leptotarsus* for the single species, *L. macquarti* Guérin. Wiedemann (1828) described *Conosia irrorata*, a fly of extremely wide distribution in the tropical and subtropical regions of the Old World.

The rapid development of the country in the first half of the 19th century found considerable rivalry between three describers of Diptera, Macquart (1838-1855), Walker (1834-1861) and Westwood (1835-1876). Macquart proposed 13 names, of which 7 are valid, 3 synonyms and 3 of doubtful identity, the valid names including some of the largest and showiest species of *Ischnotoma*. The materials studied by Macquart were entirely or in great part collected by the Verreaux brothers, the majority of the species being indicated as coming from Tasmania. Hardy (Proc. Linn. Soc. N.S.W., 54, 1929, 61–64) has most ably presented the evidence to show that only a portion of the Verreaux Diptera were actually collected in Tasmania and that the majority of the species were presumably taken in the near vicinity of Sydney. This conception quite changes our ideas of many of the Macquart species and affects certain of the Tipulidae. As regards this family, I consider it as assured that some of the species (as some *Ischnotoma* and *Macromastix*, notably *M. macquartiana* Alexander) were actually taken in Tasmania but that in the majority of cases, the specimens were taken in coastal New South Wales, as shown by Hardy. The early rivalry between Walker and Westwood, where certain of the best-known species of Australian Tipulidae (*Ptilogyna ramicornis*, *Gynoplistia bella*) were evidently characterized under different names from the self-same specimens by the two authorities, is unfortunate. Walker proposed 19 names, of which 10 are valid, 7 are synonyms and 2 remain doubtful, the valid species including such familiar forms as *Ptilogyna ramicornis*, *Plusiomyia gracilis*, *Ischnotoma par* and *Gynoplistia bella*. Westwood proposed 12 names, 6 being valid, 5 synonyms, while 1 remains of doubtful identity, the valid species including some of the finest of Australian Tipulidae, notably the two species of *Semnotes* described in 1876.

The voyage of the "*Novara*", as reported for the Diptera by Schiner (1868) produced 4 Tipulidae, of which 2 are valid, 2 synonyms. The valid species are somewhat noteworthy, including *Gynoplistia melanopyga* and *Eriocera metallica*. In 1921, through the kind interest of Dr. Hans Zerny, I was enabled to examine the types of these two species and so ascertain the true systematic position of the second named, this being a true *Eriocera*. The Tipulidae of the voyage of the "*Eugénie*" as recorded by Thomson (1869) yielded two species, one of which (*Gymnastes fascipennis*) is valid but, at the same time, unfortunately preoccupied, the name thus requiring replacement by *cordialis* (1887), the sole contribution of Osten-Sacken to the nomenclature of the Australian Tipulidae. Loew (1851)

in an unfortunate re-naming of a preoccupied species created a synonym of the already overburdened *Ptilogyna ramicornis*.

2. *The period of Skuse.*

The great pioneer worker on the crane-flies of Australia, Frederick A. A. Skuse, published three papers dealing with this subject, two of which (Proc. Linn. Soc. N.S.W., (2) 4, 1889, 757–892, Pl. 21–24 and (2) 5, 1890, 53–139, Pl. 4–6) are monographic treatments of the two chief subfamilies of the Tipulidae. Skuse proposed 107 names in the Australian Tipulidae, almost all of which are valid, and gave us our first true conception of this very remarkable fauna, as the abundance of the genera *Dolichopeza*, *Limnophila*, *Gynoplistia*, and *Molophilus*, and the definition of many beautiful new Tipuline types, as *Clytocosmus*, *Plusiomyia*, and *Platyphasia*.

For the data included in the following brief account of the life of Skuse, and especially for the opportunity of reproducing what appears to be the only known existing portrait of him, I am very deeply indebted to Mr. Walter W. Froggatt. I take the liberty of quoting parts of a letter from Mr. Froggatt (February 7, 1927), which gives a particularly clear idea of the conditions under which Parts vii and viii of the "Diptera of Australia" were prepared.

"I always considered F. A. A. Skuse one of our best entomologists, and it was a great pity that he got into bad company, personally went 'to the dogs' and died at the age of 33. He commenced life in England as a student in the British Museum of Natural History, and tried to get a position with C. Waterhouse. There being no opening, he got an introduction to Sir Daniel Cooper, the Agent-General in London for New South Wales, who advised him to try this country where he thought there would be openings for Zoologists. He came out to Sydney, arriving early in 1889 or late in 1888. His first record was giving a series of lectures at the Sydney School of Arts on popular Natural History. He was introduced to the Hon. William Macleay, afterwards Sir William Macleay, a wealthy landowner and founder of the Linnean Society of New South Wales. Macleay was a wonderful man and the leading amateur scientific worker in Australia. He helped everybody who wanted to work at Science and kept open house for all visiting scientists. He gave me my opportunity when I came back from an exploring expedition in New Guinea, and helped me in every way. The Macleay Museum was housed at Elizabeth Bay. I collected for it all over Queensland and north-western Australia and in off times was on the staff of the Macleay Museum. I had leave from Sir William on my return from West Australia in 1888, and had a trip to England. On my return early in 1889, I found Skuse installed in the Macleay Museum, working up the Diptera. This was a very fine collection, built up at Macleay's expense, who also sent Skuse on collecting trips round the country for fresh material.

"Skuse and I worked side by side in the old Museum, with Macleay in one corner describing beetles up till 12 o'clock every day. Skuse and I spent all Saturdays and holidays collecting and wandering through the wonderful Hawkesbury sandstone scrub. He was the son of a Church of England parson, he told me, but I don't remember his natal place (must have been born in 1863, from the date of death). A very well educated, handsome, charming young fellow. He was a great worker all the time he was with us in the Macleay Museum, where all his good work was done, and he had a free hand from Macleay to work as he liked. He was there three years.

"A. S. Olliff, another young English entomologist, was promoted from the Australian Museum to the newly-created Department of Agriculture. Skuse applied for the position of Entomologist to the Australian Museum, to which he was appointed in September, 1890. Here he got into bad company and did practically no work of any great value. He died on the 10th of June, 1896, aged 33, in Sydney, a perfect physical wreck. He had married about a year previously, and I believe there was a son born after his death, but Mrs. Skuse married again and I never met her. I have a very good photograph of him taken when he was at his best, about 1889."

One cannot but feel the deepest sorrow and keen regret for the various occurrences that led to the early demise of this highly capable student. From a critical line-by-line study of all of Skuse's publications on the Australian Tipulidae, I would consider him as being one of the most intelligent workers on this group of flies, the equal of Osten-Sacken and Bergroth and the inferior of no one. The photograph here reproduced (Plate ii) was taken when Skuse was about 26 years of age and at the exact period of the preparation of the monographs on the Tipulidae. The present writer has long felt the coincidence that the date of publication of the first part of Skuse's Australian Tipulidae—September 25, 1889—was the date of his own birth in the distant United States.

The different genera and subgenera of Tipulidae described by Skuse have had varied fates. Some (*Lechria, Thrypticomyia*) are now known to range widely to the west in the Oriental, or even to the Ethiopian Region. Still others, *Tasiocera, Leiponeura* (which equals *Lipophleps* Bergroth), and *Rhabdomastix*, have a much more extensive distribution, including the New World. Certain Tipuline genera (*Clytocosmus, Plusiomyia, Platyphasia, Ischnotoma*) seem to be confined to Australia, but others (*Acracantha, Habromastix*) are more widely distributed.

3. *The post-Skusean period.*

Following the passing of Skuse, nothing seems to have been done on the Australian Tipulidae until 1914 when Edwards described *Styringomyia bancrofti*. In 1919 the present writer began a study of the Tipulidae of Australia and Tasmania, resulting in the publication of some 45 titles to the end of 1930, these papers describing as new more than 400 species of Australian Tipulidae. The beautiful *Clytocosmus lichtwardti* was described by Riedel in 1920.

This recent study of the Australian Tipulidae and allied families has added some notable groups to the fauna, including the Tanyderidae and Trichoceridae, the Bruchomyiine Psychodidae, and in the Tipulidae, the subfamily Cylindrotominae, together with such notable genera and subgenera as *Phacelodocera, Megistocera, Rhipidia, Antocha, Tonnoiromyia, Tonnoirella, Horistomyia, Skuseomyia, Eriocera, Elephantomyia, Austrolimnobia, Cryptolabis* and *Toxorhina*.

Distribution.

1. *General facies of the Australian fauna.*

Australia is very rich in autochthonous Tipuline genera, notably the group with branched antennae, as *Clytocosmus, Ctenogyna, Ptilogyna, Platyphasia* and *Plusiomyia*. The closely related *Phacelodocera* has one species in Tasmania, with one other in Brazil. Other noteworthy groups of Australian Tipuline crane-flies are *Semnotes* and *Leptotarsus*, with allies in Chile; *Acracantha*, in New Zealand and Chile; *Habromastix*, in South Africa and southern South America; *Macromastix*, in New Zealand, New Caledonia, Chile, and fossil in Baltic amber. Other

autochthonous genera in this subfamily include *Phymatopsis* and *Ischnotoma*. Major Tipuline groups that have invaded the continent only in the extreme north are *Tipula*, *Nephrotoma* and *Ctenacroscelis*, represented here only by a mere fraction of their total vast numbers. The genus *Dolichopeza* is very rich in species, with allied forms in New Zealand but not in Chile. The origin of these Australian species of *Dolichopeza* is doubtful, since their nearest relatives in the Malayan region are members of other subgenera, as *Nesopeza* and *Mitopeza*. The occurrence of a single species of *Brachypremna* in north Queensland is a matter of note, as all other members of the genus are from the New World. *Megistocera* is represented by a single widespread Austro-Malayan species.

The Cylindrotominae have only the endemic genus *Stibadocerodes*, allied to the Oriental genera *Stibadocera* and *Stibadocerella*, and to the Chilean genus *Stibadocerina*. The great genus *Limonia* has several very characteristic subgenera, notably *Dicranomyia* and *Geranomyia*. *Limonia*, s.s., and *Rhipidia* are represented by comparatively few species, although with hosts of forms elsewhere in the world. *Discobola* is worthy of special mention, since the single species has its near allies in New Zealand, but not in Chile. Austro-Malayan elements in *Limonia* are found in the subgenera *Thrypticomyia*, *Pseudoglochina* and *Libnotes*. *Dapanoptera* is a southern representative of a highly characteristic Papuan group, while *Idioglochina* has two species on the Queensland coast, with numerous others on many of the Pacific islands, probably all of which are marine in habit. The genus *Helius* has two subgenera, one, the typical subgenus, having representatives in all the major regions of the globe, including New Zealand, the other, *Eurhamphidia*, being more essentially Austro-Malayan. *Antocha* has only the subgenus *Orimargula*. *Orimarga* is represented only by the typical subgenus. The isolated genus *Tonnoiromyia*, with two species in south-eastern Australia and one other in Chile, is of the greatest interest from the standpoint of distribution.

The genus *Lechria*, described from Australia, is now known to be a highly characteristic Austro-Malayan group. The Pediciini has only a single genus, *Tricyphona*, with two species in Australia, one being from the east, the other from the west. Three additional species occur in New Zealand, with a few others in southern Chile and Patagonia. The primitive Hexatomini, such as *Austrolimnophila*, are represented by several showy species, though not so well developed in species as either New Zealand or Chile. Autochthonous Hexatomine genera include several notable types, as *Tonnoirella*, *Horistomyia*, *Bergrothomyia*, *Skuseomyia* and *Diemenomyia*. *Limnophila* and *Epiphragma* have rather numerous Australian representatives. *Ischnothrix* is of great interest, having several species in Australia, New Zealand and South America. The most characteristic Antarctogaean genus of crane-flies is *Gynoplistia*, with five subgenera, four of which occur in Australia. Of these *Xenolimnophila* is endemic; *Cerozodia* is found only in Western Australia and in New Zealand; *Paralimnophila* reaches its greatest development in eastern Australia, where occur species with simple antennae, as well as others showing the greatest development of antennal flabellation so far found in the subgenus; elsewhere *Paralimnophila* has only representatives with simple antennae, there being a few in New Zealand, several in Chile, while one, *G. (P.) conspersa* (Enderlein), reaches southern Brazil, where it is associated with some other crane-fly groups that are otherwise known only from south-eastern Australia (as *Phacelodocera*). The typical subgenus, *Gynoplistia*, is tremendously developed throughout the Australasian region, with several forms in Australia, many more in New Zealand, and with fewer species in the Papuan

subregion as far west as Celebes, and still others in Chile. The abundant and widespread genus *Erioccra* has four species only. *Elephantomyia* is represented by the typical subgenus in the south, with closely allied species in New Zealand and Chile, and by the subgenus *Elephantomyodes* in the north, this representing a characteristic Austro-Malayan element.

In the Eriopterini, *Conosia* has a single species with a wide range in the palaeotropics. *Austrolimnobia* is endemic, with two species in Victoria and Tasmania. *Gonomyia* has but two of the five recognized subgenera, these being the vast group *Lipophleps*, together with *Ptilostena* occurring only in the northeast. Other elements that have entered the continent from the north include *Teucholabis*, *Gymnastes*, *Trentepohlia*, *Styringomyia* and *Toxorhina*, the latter with the single subgenus *Ceratocheilus*. The most characteristic genus of small crane-flies in Australia is *Molophilus*, with some 150 species already described and many others awaiting discovery. This genus is almost equally well developed in New Zealand and in the Chilean region, indicating an Antarctic origin for the group. *Tasiocera*, with several species in Australia and almost equal numbers in New Zealand but only a few elsewhere in the world, deserves special mention as being one of the most characteristic genera of small crane-flies in the fauna. *Cryptolabis*, *Amphineurus* and *Rhabdomastix* have evidently been dispersed over the former Antarctic continent, since all have closely allied forms in southern Chile. *Erioptera* has two isolated species (*amabilis* and *delectabilis*) in southeastern Australia, with other more normal species in the east, these latter elements having evidently been derived from the north. *Trimicra* is represented by one or possibly more species that have been generally identified with the widespread *pilipes* of Europe, but which may prove to be distinct when more carefully examined.

The details of distribution of the various components of the Australian crane-fly fauna is best shown by the accompanying tabular arrangement.

2. *Comparison of the Tipulid fauna of Australia and New Zealand.*

One of the greatest surprises in a study of the Diptera of Australasia is the almost total distinctness of the species occurring in Australia and in New Zealand, the chief exceptions being in those groups that are spread through the agency of man. As regards the Tipulidae, no single species is known from both these areas, the nearest approach being in groups such as *Trimicra*, where the specific limits are not well understood.

At the time of issue of Tillyard's "Insects of Australia and New Zealand", 1926, only 250 species of Tipulidae were known from Australia and Tasmania, as contrasted with 500 species described from New Zealand. Intensive collecting in the past five years has remedied this deficiency for the continental area, there now being nearly 600 species known from Australia, while the fauna of New Zealand has remained nearly at the former figure. It is certain that the Commonwealth will be found to have a Tipulid fauna greatly exceeding in numbers of genera and species that of New Zealand, although this preponderance will by no means be proportional to the relative size of the areas.

A brief contrast of the two regions is of much interest.

Australia is characterized by a great development of genera of Tipulinae having branched antennal segments (*Clytocosmus*, *Plusiomyia*, *Platyphasia* and others), these having no counterpart in the Maorian subregion. This latter area is also lacking in several important widespread to cosmopolitan genera that have

Group.	Australasian.			Oriental.	Ethiopian.	E. Palaearctic.	W. Palaearctic.	Nearctic.	Neotropical.	
	Australia.	New Zealand.	Papuan.						Extra-Chilean.	Chilean.
Tipulinae										
Clytocosmus ..	*									
Ctenogyna ..	*									
Ptilogyna	*									
Plusiomyia ..	*									
Phacelodocera ..	*								*	
Platyphasia ..	*									
Ischnotoma	*									
Acracantha ..	*	*								
Leptotarsus ..	*									*
Semnotes	*									
Phymatopsis ..	*									
Habromastix ..	*				*				*	
Macromastix ..	*	*	*	*						*
Ctenacroscelis ..	*		*	*	*	*				
Tipula	*		*	*	*	*	*	*	*	*
Nephrotoma ..	*		*	*	*	*	*	*	*	
Megistocera ..	*		*	*	*			*	*	
Brachypremna ..	*							*	*	
Dolichopeza, s.s. ..	*	*			*		*	*		
Cylindrotominae										
Stibadocerodes ..	*									
Limoniinae										
Limoniini										
Limonia										
Limonia ..	*	*	*	*	*	*	*	*	*	*
Discobola ..	*	*		*		*	*	*	*	
Dicranomyia ..	*	*	*	*	*	*	*	*	*	*
Rhipidia ..	*			*	*	*	*	*	*	
Geranomyia ..	*			*	*	*	*	*	*	*
Thrypticomyia ..	*		*	*	*	*				
Libnotes	*		*	*	*	*				
Dapanoptera ..	*		*							
Idioglochina ..	*	*	*	*		*				
Pseudoglochina ..	*			*						
Helius										
Helius	*	*		*	*	*	*	*	*	
Eurhamphidia ..	*			*	*					
Antocha										
Orimargula ..	*			*	*	*	*			
Orimarga										
Orimarga ..	*		*	*	*	*	*	*	*	
Tonnoiromyia ..	*									*
Lechriini										
Lechria	*			*						

Group.	Australasian.			Oriental.	Ethiopian.	E. Palaearctic.	W. Palaearctic.	Nearctic.	Neotropical.	
	Australia.	New Zealand.	Papuan.						Extra-Chilean.	Chilean.
Pediciini										
Tricyphona ..	*	*		*		*	*	*		*
Hexatomini										
Austrolimnophila ..	*	*								*
Epiphragma ..	*			*		*	*	*	*	
Tonnoirella ..	*									
Horistomyia ..	*									
Limnophila ..	*	*	*	*	*	*	*	*	*	*
Bergrothomyia ..	*									
Skuseomyia ..	*									
Diemenomyia ..	*									
Ischnothrix ..	*	*								*
Gynoplistia										
Gynoplistia ..	*	*	*							*
Cerozodia ..	*	*								
Xenolimnophila ..	*									
Paralimnophila	*	*								*
Eriocera	*			*	*	*		*	*	
Elephantomyia										
Elephantomyia ..	*	*		*	*	*	*	*	*	*
Elephantomyodes	*			*						
Eriopterini										
Conosia	*			*	*	*	*			
Austrolimnobia ..	*									
Gonomyia										
Lipophleps ..	*	*	*	*	*	*		*	*	
Ptilostena ..	*			*	*	*	*	*		
Teucholabis ..	*			*	*	*		*	*	
Gymnastes										
Paragymnastes ..	*									
Trentepohlia										
Mongoma ..	*			*	*	*				
Trentepohlia ..	*			*	*	*	*			
Rhabdomastix										
Rhabdomastix ..	*			*					*	*
Sacandaga ..	*	*				*	*	*	*	
Erioptera, s.s. ..	*			*	*	*	*	*	*	*
Molophilus ..	*	*		*	*	*	*	*	*	*
Cryptolabis, s.s. ..	*							*	*	*
Tasiocera	*	*		*	*					*
Amphineurus										
Amphineurus ..	*	*								*
Trimicra	*	*		*	*	*	*	*	*	*
Styringomyia ..	*			*	*	*			*	
Toxorhina										
Ceratocheilus ..	*	*	*	*	*				*	

invaded Australia only in the north (*Tipula*, *Nephrotoma*, *Megistocera*). Other important Tipuline genera of Australia that do not occur in New Zealand include *Semnotes*, *Leptotarsus*, *Ischnotoma* and *Habromastix*. Important Tipuline genera common to the two areas include *Dolichopeza*, *Acracantha* and *Macromastix*. The most important Tipulinae in New Zealand having no vicarious representatives in Australia are found in the genus *Zelandotipula* (which is evidently distinct from *Ctenacroscelis*, being more nearly allied to certain Chilean species of *Holorusia*) and in three noteworthy subgenera of *Macromastix*—*Chlorotipula*, including the familiar green crane-flies of New Zealand; *Aurotipula*, the equally conspicuous orange and black species; and the more isolated *Maoritipula*. The relationship of the New Zealand *Hudsonia* to the Australian *Phymatopsis* seems to be very close.

The Cylindrotominae (*Stibadocerodes*) and Lechriini (*Lechria*) of the Australian fauna have no representatives in New Zealand.

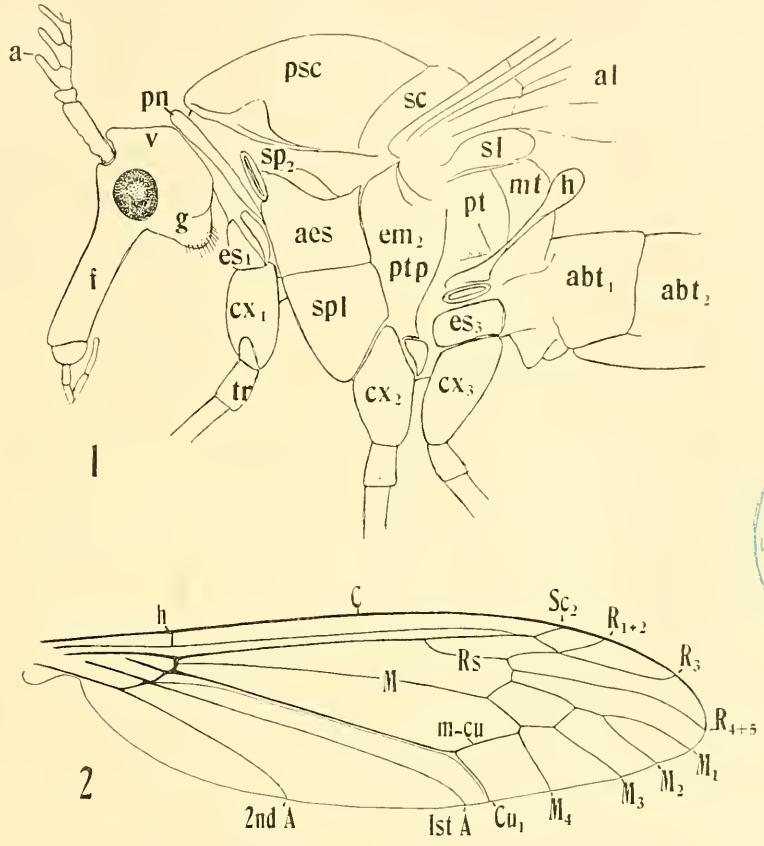
The remaining four tribes of Limoniinae are rather proportionately developed in the two regions. Australia has ten subgenera in the great genus *Limonia*, whereas New Zealand has but five, of which *Discobola*, *Dicranomyia* and *Zelandoglochina* are especially characteristic, the last having no representatives in Australia. Of the remaining four subtribes of Limoniini in the Commonwealth, only one, the Heliaria, with a single species of *Helius*, is found in New Zealand. The Pediciini are of great interest in that a few closely allied species of *Tricyphona* occur in the two regions, with still others in Chile. The Hexatomini have a number of characteristic genera common to the two regions, notably *Austrolimnophila*, *Limnophila*, *Ischnothrix*, *Gynoplistia* and *Elephantomyia*. Each of the regions possesses a number of isolated Hexatomine types, Australia having such genera as *Tonnoirella*, *Horistomyia*, *Bergrothomyia*, *Skuseomyia* and *Diemenomyia*, while New Zealand has *Rhamphophila*, *Tinemyia*, *Nothophila*, *Metalimnophila* and *Harrisomyia*. Australia has in *Eriocera* a few species of the subtribe Hexatomaria, the group being quite absent from New Zealand.

The Eriopterini of the two regions have several features in common, notably the vast development of the two groups *Molophilus* and *Tasiocera*. Other common features lie in the possession of such groups as *Gonomyia* (subgenus *Lipophleps*), *Rhabdomastix* (*Sacandaga*), *Toxorhina* (*Ceratocheilus*), and the typical subgenus of *Amphineurus*. Australia has gained several immigrant genera from the north that are quite lacking in New Zealand, such elements being found in *Conosia*, *Teucholabis*, *Gymnastes*, *Trentepohlia* and *Styringomyia*. The isolated genera *Astelobia* and *Aphrophila* are found in New Zealand and again in Chile, but not in Australia or Tasmania, being relicts of the penultimate Antarctic land-connection, as postulated by Tillyard. One species of *Erioptera* (*Empeda*) in New Zealand has no representative yet discovered in Australia. Other isolated Eriopterine groups in New Zealand are *Campbellomyia* and some peculiar subgenera of *Amphineurus*, as *Nesormosia* and *Nothormosia*. On the other hand, Australia has scarcely any endemic Eriopterine genera, the most notable being *Austrolimnobia*.

General Morphology.

Following the plan of the present series of papers, it is not deemed necessary to enter into any detailed discussion of morphological terminology. A wealth of literature is now available to the interested student, a score of titles being provided that cover the various regions of the insect body. These papers are

selected with special reference to their direct citations to the Tipuloidean flies. For all general purposes, the excellent discussion of Dipterous morphology given by Tillyard ("Insects of Australia and New Zealand", 1926, pp. 333–341, figs. W_1–W_{13}) will provide ample information. The general features of morphology of the head and thorax of *Clytocosmus*, together with the venation of the same, are shown in the accompanying text-figures.



Text-figs. 1, 2.

1.—Lateral aspect of body of *Clytocosmus helmsi* Skuse.—*a*, antenna; *abt*, abdominal tergite; *aes*, anepisternum (mesepisternum); *al*, wing; *cx*, coxa; *em*, epimeron; *es*, episternum; *f*, frons; *g*, gena; *h*, halter; *mt*, postnotal mediotergite; *pn*, pronotum; *psc*, praescutum; *pt*, postnotal pleurotergite; *ptp*, pteropleurite (mesepimeron); *sc*, scutum; *sl*, scutellum; *sp*, spiracle; *spl*, sternopleurite (mesepisternal katepisternum); *tr*, trochanter; *v*, vertex.

2.—Wing of *Clytocosmus helmsi* Skuse.—A, anal veins; C, costa; Cu, cubitus; h, humeral crossvein; M, media; m-cu, medial-cubital crossvein; R, radius; Rs, radial sector; Sc, subcosta.

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SYSTEMATIC REVIEW OF THE TIPULIDAE.

The remainder of the present paper, as well as the series to follow, will be devoted to a systematic treatment of the Australian species of crane-flies. The keys provided at this time include only those to the subfamilies, the genera of the subfamily Tipulinae, and the species of the genus *Clytocosmus*.

Key to the subfamilies of Tipulidae.

1. Last segment of maxillary palpus elongate, whiplash-like; nasus usually distinct; antennae with not more than 15, usually with 13, segments; wings with Sc_1 usually obliterated, Sc thus apparently ending in R; vein Cu_1 constricted at m-cu, the latter close to the fork of M_{3+4}, or more distad on M_4 ..... Tipulinae

   Last segment of maxillary palpus short, subequal to the others; no nasus; antennae with fewer than 13 segments (*Eriocera*) or with from 14 to 39 segments; wings with Sc_1 preserved, Sc thus ending in C; m-cu in most cases at, before or only a short distance beyond the fork of M, only very rarely at the fork of M_{3+4} (*Skuseomyia*); Cu_1 not constricted at point of insertion of m-cu 2

2. Wings having r-m connecting with Rs at or before the fork; extreme tip of R_{1+2} atrophied, producing the appearance of a long apical fusion of vein R_{1+2+3} back from the margin ..... Cylindrotominae
Wings having r-m connecting with R_{4+5} or R_5 beyond the fork of Rs (except in *Helius: Eurhamphidia*); no appearance of a long apical fusion of vein R_{1+2+3} back from the margin ..... Limoniinae

Various exceptions to the above statements are to be found. *Phymatopsis brevipalpis* Alexander, has the terminal segment of the maxillary palpus short. Many genera of Tipuline crane-flies in the Australian fauna lack the nasus. *Semnotes* and *Leptotarsus* have only 8 to 10 antennal segments.

Several species of subapterous Tipulidae have been found in Australia. Their subfamily positions may be determined by the non-venational characters outlined above. The species with vestigial wings so far discovered in the Commonwealth fall in the following genera.—Tipulinae: *Plusiomyia* Skuse, *Phymatopsis* Skuse, *Macromastix* Osten-Sacken; Limoniinae: *Limnophila* Macquart, *Gynoplistia* (*Xenolimnophila* Alexander), *Molophilus* Curtis.

As a general rule, only the female sex is subapterous, the condition involving the males only in *Xenolimnophila* among the known species.

Key to the genera of Tipulinae.

1. Wings with cell 1st M_2 open by the atrophy of the basal section of M_3, giving a pectinate appearance to the medial field ..... *Dolichopeza* Curtis
Wings with cell 1st M_2 closed 2
2. Wings with r-m before the fork of Rs; R_{2+3} almost perpendicular at origin and angularly bent at near midlength; vein M_4 at base directed proximad to point of union with m-cu ..... *Megistocera* Wiedemann
Wings with none of the venational characters listed 3
3. Wings with Sc very long, Sc_1 preserved, separated on costa from the free tip of Sc_2 by a distance about equal to one-half the latter; R_3 nearly perpendicular; cell 2nd A reduced to a linear strip ..... *Brachypremna* Osten-Sacken
Wings without the above combination of characters; Sc_1 usually atrophied and cell 2nd A wide 4
4. Wings with vein M_{3+4} lacking, vein M_4 leaving directly from the end of vein M at or before the level of the remaining elements of the cord; Rs short and nearly transverse, simulating a crossvein, in approximate transverse alignment with the other elements of the cord ..... *Nephrotoma* Meigen
Wings with M_{3+4} present, M forking into the two elements M_{1+2} and M_{3+4}; Rs longer, not simulating a crossvein 5
5. Vein R_3 bent strongly caudad at near midlength, so cell R_3 is strongly narrowed at this point (least constricted in *C. aberrans* Alexander) ..... *Ctenacroscelis* Enderlein
Vein R_3 nearly straight, gently sinuous, or gently curved throughout its entire length, not as above 6
6. Antennae with a certain number of definitely branched segments (male); in the female with the tendency more reduced to a subpectinate or subserrate condition 7
Antennae without definitely branched segments in the males, simple or nearly so in the females (compare some *Ischnotoma* species, couplet 14) 13
7. Antennae with a single branch on each of flagellar segments 2 to 8 ..... *Platyphasia* Skuse
Antennae with two or three branches on individual basal flagellar segments 8
8. Wings with r-m obliterated by the fusion of vein R_{4+5} on M_{1+2} .. *Ptilogyna* Westwood
Wings with r-m present 9
9. Antennae with three pectinations on individual flagellar segments, two being basal, one more apical, being placed at or beyond midlength of the segment 10
Antennae with not more than two pectinations, both basal 11
10. Antennae flabellate, flagellar segments 2 to 9 with three very long branches, the single outer branch only a little shorter than the basal branches ..... *Phacelodocera* Enderlein

Antennae long-pectinate to short-pectinate, scarcely flabellate; the single outer branch is usually a mere tubercle, in its greatest development (*P. clarki* Alexander) not exceeding two-thirds the basal branch ..... *Plusiomyia* Skuse (in part)

11. Anterior vertex and front in direct alignment; frontal prolongation of head long and slender; nasus lacking 12
Frontal prolongation of head short, meeting the remainder of head at an acute angle; nasus present but short and stout ..... *Ctenogyna* Macquart

12. Legs relatively short and stout; terminal simple segments of antennae with numerous very long verticils that much exceed the segments in length ..... *Clytocosmus* Skuse (in part)
Legs long and slender; terminal simple segments of antennae with relatively inconspicuous verticils that are shorter than the segments ..... *Plusiomyia* Skuse (in part)

13. A certain number of enlarged basal antennal flagellar segments, the terminal segments abruptly more slender, long-cylindrical 14
Terminal flagellar segments of antennae not differing in general form from the basal ones 16

14. Terminal segments of antennal flagellum with long conspicuous verticils that exceed the segments in length 15
Terminal segments of antennal flagellum without long verticils, these being shorter than the segments ..... *Ischnotoma* Skuse (in part)

15. Frontal prolongation of head elongate, in alignment with the anterior vertex, without nasus; legs relatively stout ..... *Clytocosmus* Skuse (in part)
Frontal prolongation of head short and stout, with a conspicuous nasus; legs long and slender ..... *Acracantha* Skuse

16. Antennae with only 8 to 10 segments 17
Antennae with from 12 to 14 segments 19

17. Antennae with not more than 8 segments; first segment of scape elongate, about two-fifths the entire antenna; first flagellar segment enlarged; maxillary palpus with short terminal segment ..... *Semnotes* Westwood
Antennae with 9 or 10 segments; first segment of scape shorter, not exceeding one-third the entire antenna; first flagellar segment not more conspicuously enlarged than the succeeding segments ..... (*Leptotarsus* Guérin) 18

18. Cell M_1 of wings lacking; antennae 9-segmented ..... Subgenus *Pseudoleptotarsus* Alexander
Cell M_1 of wings present; antennae 10-segmented .... Subgenus *Leptotarsus* Guérin

19. Nasus lacking 20
Nasus present 21

20. Antennae short in both sexes ..... *Phymatopsis* Skuse
Antennae elongate in male, subequal to entire body, in female shorter, about equal to the thorax alone ..... *Habromastix* Skuse

21. Male hypopygium of simple structure; female with fleshy valves to ovipositor (both cerci and hypovalvae) ..... *Macromastix* Osten-Sacken
Male hypopygium incrassated; ovipositor of female with chitinized valves 22

22. Wings with vein R_3 straight, in alignment with R_{3+5}; cell 2nd A narrow; claws of male toothed ..... (Australian species of subgenus *Acutipula* Alexander) *Tipula* Linnaeus
Wings with vein R_3 usually more or less arcuated; if more nearly straight, then cell 2nd A wide; claws simple in both sexes .... *Ischnotoma* Skuse (in part)

The subapterous Tipuline genera may be separated by the following supplementary key. As indicated before, only females show this condition.

1. Flagellar segments more or less branched ..... *Plusiomyia* Skuse
Flagellar segments simple 2

2. Ovipositor with the valves (cerci and hypovalvae) long and chitinized ..... *Phymatopsis* Skuse
Ovipositor with the valves (cerci and hypovalvae) blunt and fleshy ..... *Macromastix* Osten-Sacken

The only species of *Plusiomyia* with reduced wings are two found in the mountains of Tasmania. All members of the typical group of larger species of *Phymatopsis* have almost wingless females. The subapterous species of

Macromastix include the nearly wingless females of such species as *M. fergusoni* Alexander, *M. luteicosta* Alexander, and others.

Clytocosmus Skuse.

Skuse, Proc. Linn. Soc. N.S.W., (2) 5, 1890, 72 (generic key), 74–76 (generic diagnosis).—Alexander, *Ibid.*, 45, 1920, 184–185 (species key).—Alexander, *Mem. Queensland Mus.*, 7, 1920, 53.—Riedel, *Arch. f. Naturg.*, 85 A, Heft 4, 1920, 85–88 (discussion of generic limits).—Alexander, *Ann. Mag. Nat. Hist.*, (9) 9, 1922, 159–160 (species key).—Pierre, *Genera Insectorum*, Fasc. 186, 1926, 7 (generic key), 49 (generic diagnosis).—Alexander, Proc. Linn. Soc. N.S.W., 52, 1927, 58, fig. 44 (venation of radial field).

Pierre (*l.c.*) has keyed and defined the genus to include only the male sex of the genotype, *helmsi*. By this work it would be impossible to identify other species of the genus.

Generic characters.—Body unusually stout. Head prolonged into a long trunk-like rostrum, without nasus; plane of the front and vertex meeting at about a right angle, the front and rostrum in direct alignment. Antennal fossae close together at summit of vertex. Eyes relatively small, protuberant, with fine ommatidia. Genal region tumid and provided with a group of long yellow setae. The antennae are 13-segmented in the male, 13, or usually, 14-segmented in the female, with a certain number of enlarged basal flagellar segments, the greatest number of these being nine (*helmsi*), the smallest three (*lichtwardti*). In *helmsi* (male) these segments bear two conspicuous, strongly divergent, terminal branches; in *helmsi* (female) and *tillyardi* (both sexes) the basal segments are weakly bilobed; in *edwardsi* (both sexes) and *lichtwardti* (both sexes) the segments are merely obtusely rounded beneath, without bilobing. Terminal flagellar segments elongate-cylindrical, much more slender than the basal segments, with long conspicuous verticils. Both sexes of all species have on the enlarged basal segments, numerous subhyaline punctures that are set with microscopic setae; these punctures are most abundant on the pectinations and lobes of the segments, becoming few in number on the outermost modified segment.

Legs relatively short and stout. Venation (Text-fig. 2): Sc_1 lacking; Sc_2 with its free tip longer than the fusion of Sc_2 and R_1; R_2 obliterated by a short fusion of R_1 with R_{2+3} before the fork of the latter; cell M_1 short-petiolate; basal section of M_{3+4} longer than the basal section of M_3, the fork of M_{3+4} thus being at or beyond midlength of cell 1st M_2. Veins C, Sc and R with small macrotrichia, the other veins with the trichia very reduced in size and number. Postnotal pleurotergite produced into a conspicuous compressed tubercle immediately before the halteres. Male hypopygium (Text-figure 4) of primitive structure. Tergite (*t*) a depressed plate, the caudal margin with a small U-shaped median notch, the broad lobes thus formed subtruncate or with the margins sinuous; apex of tergite densely set with abundant setae. Basistyles (*b*) relatively long and slender, the outer face provided with very abundant delicate setae. Outer dististyle a flattened ear-like lobe. Inner dististyle (*id*) at base produced into a flange that is set with numerous small squat black spines that are arranged more or less in a semicircle around the margin of the basal extension. Ovipositor with the cerci long and slender, straight; hypovalvae appearing as shorter, powerful, compressed blades.

Genotype, *Clytocosmus helmsi* Skuse (by monotypy).

The peculiar antennae, with a certain number of enlarged flagellar segments that are followed by cylindrical ones bearing unusually long, conspicuous verticils, are also found in *Acracantha* Skuse (Australia, New Zealand) and *Elnoretta* Alexander (Chile).

Geographical distribution.—Almost all of the known species are surprisingly local in range, all being known from but a single State of the Commonwealth. The most widely distributed, as known, is *C. edwardsi*, which has an extensive range in southern Victoria, from the Dandenong Ranges east to Gippsland. The other species are more restricted, *helmsi* being known only from Mt. Kosciusko in southern New South Wales; *tillyardi* from the Dorrigo Plateau in northern New South Wales, while *lichtwardti* has been taken only near Herberton, North Queensland. It will be very interesting to determine which species frequents the Blue Mountains, the Barrington Tops, the Macpherson Range and other intermediate stations in the known range of the genus.

Seasonal distribution.—The species are on the wing in late Summer and Autumn.

General observations.—The large heavy body of these superb crane-flies has impressed different observers in different manners. Tillyard, writing of *C. tillyardi*, was struck by a resemblance to a large robber-fly. Wilson wrote concerning *C. edwardsi* that "when flying, it resembles more one of the large yellow and black Pompilid wasps than a Cranefly". From Wilson's observations regarding this last species, as quoted later in this review, it seems certain that the immature stages are spent in and near the margins of mountain streams. It is to be hoped that the larvae and pupae of this fly will soon be made known. Dr. G. Chester Crampton has in preparation a complete morphological treatise on *Clytocosmus tillyardi* that may well serve as a basis for all future work on this subject for the Australian fauna. A comparable study of the early stages would thus become of especial value.

Key to the Species of Clytocosmus.

1. Males 2
   Females 5
2. Stripes of mesonotal praescutum orange; antennae with the basal nine flagellar segments enlarged, each with two conspicuous branches ..... *helmsi* Skuse
   Stripes of mesonotal praescutum black; antennae with not more than seven enlarged flagellar segments, none with distinct branches 3
3. Basal three flagellar segments subpyriform; abdomen black, tergites two and three orange ..... *lichtwardti* Riedel
   Antennal flagellum with from five to seven enlarged segments; abdomen with the orange pattern on basal tergites lacking or reduced to a ring on the second segment 4
4. Abdominal tergites black and white, only the genital segments brightening to orange; antennae with five enlarged segments, these with the lower face merely rounded ..... *edwardsi* Alexander
   Abdominal tergites black and white, the base of the second segment narrowly ringed with orange; antennae with seven or eight enlarged segments, the basal five or six weakly bilobed ..... *tillyardi* Alexander
5. Stripes of mesonotal praescutum black; antennae with only three enlarged flagellar segments ..... *lichtwardti* Riedel
   Stripes of mesonotal praescutum orange; antennae with at least five enlarged flagellar segments 6
6. Prothorax, mesonotal scutellum and postnotum black; thoracic pleura black, spotted with white; antennae with eight or nine enlarged flagellar segments, all but the ultimate ones of which are bilobed ..... *helmsi* Skuse

Prothorax, mesonotal scutellum and postnotum orange; thoracic pleura orange, spotted with white; antennae with not more than eight enlarged flagellar segments, none of which is bilobed 7

7. Abdominal tergite two with its basal ring orange; tergite seven orange; antennae with seven or eight enlarged flagellar segments, all but the ultimate cordiform, strongly produced beneath ..... *tillyardi* Alexander

Abdominal tergites one to seven black, spotted with white, without orange markings; antennae with four or five enlarged flagellar segments, all but the ultimate merely rounded beneath ..... *edwardsi* Alexander

The above key illustrates the striking colour dimorphism found in certain of the species. *Clytocosmus helmsi* and *C. lichtwardti* have the sexes generally similar in coloration, but *C. edwardsi* and *C. tillyardi* are entirely dissimilar, having nearly black males and chiefly orange females. This sexual dimorphism led me into the error of describing the black males of *C. tillyardi* as a supposed new species which was defined as *C. skusei.*

Clytocosmus helmsi Skuse.

Skuse, Proc. Linn. Soc. N.S.W., (2) 5, 1890, 76–77, plate 4, fig. 5 (adult male); 5*a*, male antennae; 5*b*, apex of same; 5*c*, head, lateral aspect; 5*d–f*, female antennae, with details.—Alexander, *Ibid.*, 45, 1920, 184.—Alexander, *Ann. Mag. Nat. Hist.*, (9) 9, 1922, 160.—Pierre, Diptera, Tipulidae, Tipulinae, Genera Insectorum, Fasc. 186, 1926, 49, plate 5, fig. 9 (wing), fig. 10 (male antennae), fig. 11 (female antennae).

Sexes generally alike in colour; antennae of both sexes (Plate ii, figs. 1, 2) with nine (rarely eight in female) enlarged flagellar segments, those of male with two conspicuous apical branches, of the female merely bilobed; ground-colour of mesonotal praescutum and scutum orange, with four scarcely differentiated darker orange stripes; cephalic portion of praescutum more or less suffused with blackish; scutellum, postnotum and pleura black, variegated with silvery-white areas; abdomen black, variegated with conspicuous silvery-white areas, the genital segments of both sexes orange.

The antennae (male) show the greatest development of pectination of any of the discovered species. The first nine flagellar segments each bear two conspicuous branches, apical in position; basal segment stout-based, the succeeding segments more slender, their bases shorter than the branches except on the ninth segment, where the branches are shorter and tend to be unequal in length; tenth flagellar segment elongate-cylindrical, simple, with numerous conspicuous setae that are more than one-third the length of the segment; terminal segment short, subconical. In the female, the antennae have thirteen or fourteen segments, the basal eight or nine flagellar segments enlarged, with all but the last of these weakly and asymmetrically bilobed, the segments being conspicuously produced on the ventral face into a cylindrical lobe; on the first and again on the outer segments these lobes become smaller and more obtuse; last enlarged segment with a simple lobe; terminal three segments cylindrical, the last elongate-cylindrical, all with long conspicuous setae. It seems probable that there is a terminal button-like segment, not indicated in my material, in which case the organ in this sex would have as many as fifteen segments in certain individuals.

Distribution.—Skuse described this superb fly from three specimens, representing both sexes taken at Moonbar, Mt. Kosciusko, altitude 3,000–3,500 feet, in March, by Mr. R. Helms. The types are preserved in the collection of the Aus-

tralian Museum, Sydney. The only subsequent records of occurrence of the species seem to be at various altitudes on Kosciusko. Nicholson took specimens at altitudes as high as 5,500 feet in February, as described in his account of the species later in the present paper. Other material has been taken at 5,000 feet (February 4, 1929, Tillyard) and 4,000 feet (L. Harrison).

Observations.—The following account of the occurrence and habits of this fly are contained in a letter from Dr. A. J. Nicholson, dated November 15, 1927.

"With regard to your inquiries about *Clytocosmus helmsi.* I found this insect on Mount Kosciusko at a height of about 5,500 feet, where it was extremely common. The country may be described as a mountain heath; it is practically treeless, slightly marshy in places and is covered with small low-growing bushes which appear to correspond ecologically with the heaths and heathers of the Holarctic Region. *C. helmsi* appears to be commonest amongst the bushes near small streams, but this may be due to the fact that most of the collecting was carried out in such situations. It was very noticeable that while this insect was very common at 5,500 feet, it was quite scarce at 5,000 feet in similar country. This I believe to be due to the modifying influence of altitude on the season, for earlier in the year Prof. Harrison found *C. helmsi* in large numbers at about 4,000 feet. It is very noticeable here that the period during which a particular species of insect appears at a given altitude is very short in the mountainous regions.

"As you may imagine, *C. helmsi* is very conspicuous when alive, whether flying or settled. Its flight is clumsy and slow; the body hangs vertically and the rapidly vibrating wings appear only with difficulty to be able to support the ungainly body and propel it with a slow drifting motion through the air. While flying, the long and conspicuous legs are spread out to their full extent and execute slow waving movements. When settled, the insect appears to be always found in the most conspicuous possible situation. Usually it settles near the top of a plant and fully exposed on the outside, and its conspicuous coloration attracts attention to it immediately. The wings are folded over the back, as is shown in the photograph I am inclosing. The photograph is a flashlight taken at night of the insect in its natural environment. It is quite typical of the exposed situation of the resting insect, whether by day or night." I am very greatly indebted to Dr. Nicholson for the privilege of reproducing this unusually fine photograph (Plate ii, fig. B).

Clytocosmus edwardsi Alexander.

Alexander, *Ann. Mag. Nat. Hist.* (9), 9, 1922, 158–159.—Pierre, Diptera, Tipulidae, Tipulinae, Genera Insectorum, Fasc. 186, 1926, 49.—Wilson *Vict. Nat.*, 46, 1929, 91–92.

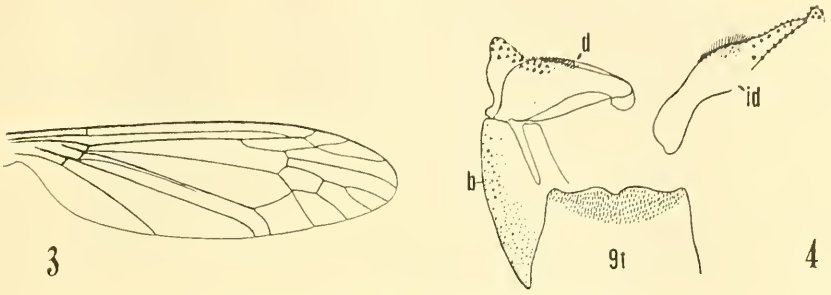
Sexes dissimilar in coloration, the males having the thoracic pattern (both dorsum and pleura) black and silvery-white, the females with the black colours replaced by orange; abdomen black, variegated with silvery-white spots, the genital segments of both sexes orange; antennae of both sexes (Plate ii, figs. 4, 5) identical or nearly so, there being five enlarged flagellar segments that are merely rounded on their lower face.

Antennae almost identical in structure in the two sexes; five enlarged flagellar segments that gradually decrease in size outwardly, the last being only a little thicker than the simple segment beyond; verticils of the enlarged

segments decreasing slightly in length and becoming more numerous on the outer segments, on the simple outer segments being very long and numerous.

In some specimens of *edwardsi*, the first scapal segment of the male antenna is black, while in others it is orange, as is the case in the other species of the genus.

The wing (Text-fig. 3) and male hypopygium (Text-fig. 4) are figured.



Text-figs. 3,4.

3.—Wing of *Clytocosmus edwardsi* Alexander.

4.—Male hypopygium of the same; dorsal aspect.—b, basistyle; d, dististyles; id, inner dististyle; t, tergite.

Distribution.—*Clytocosmus edwardsi* is widely distributed in the mountains and fern-gullies of Victoria, appearing on the wing in late Summer and Autumn. The following records are available from various sources:

Dandenong Ranges (National Museum, Melbourne); Ferntree Gully, March 21, 1908 (National Museum, Melbourne); Monbulk (ex Brunetti collection, in the British Museum); mountains above Millgrove, on Mt. Donna Buang from altitudes of 450 feet to 3,800 feet, March, April (Wilson); Kinglake, May 12–13, 1914 (National Museum, Melbourne); Gippsland, April, 1906 (National Museum, Melbourne).

Observations.—Various observations by F. Erasmus Wilson constitute our sole information on the habits of this crane-fly.

"*Clytocosmus* were again met with, one male and one female being captured and a few others seen. They were at exactly the same spot where I secured the specimen last year (above Millgrove, on the Dee tributary of the Yarra river). When disturbed, the insect rises up to about 20 feet and then slowly flies about in large circles, frequently passing overhead again, at other times alighting thirty to forty yards away. They seem to show a preference for *Eucalyptus* leaves as a resting site."—F. E. Wilson, in litt., April, 1928.

"*Clytocosmus* were on the wing and very beautiful they looked as they sailed over our heads. I have never seen so many in my life before, as from this spot (altitude about 450 feet) to nearly the top of the mountain (Donna Buang, 3,800 feet) we were frequently observing them. Most of those seen were females, and incidentally I was able to learn a little of their domestic habits. I was standing on the edge of a little pool later in the day when I saw a big female plane down from the top of a *Leptospermum* bush, cross the pool, almost touching the water and finally alight at the water's edge. She then walked fairly fast about ten inches from the margin and inserted her ovipositor into a crevice in the mud. She then advanced about another twelve inches and crawled into a

depression under a big stone where she feverishly began drilling operations. Often the implement would meet with some obstruction and another place had to be tried. I noticed that she made a slight twisting motion with her abdomen when inserting the ovipositor. I estimated that she laid about a dozen eggs in that little depression. I then caught and killed her and found that she had practically exhausted her egg-supply as only two were left. These are rod-like, with rounded ends (capsule-shaped), barely a millimeter in length and of a pale yellow colour. To me they appeared surprisingly small for so large an insect. Later I disturbed others from patches of damp earth near seepages and streams so I think we can safely say that we now know where these beauties breed."—F. E. Wilson, in litt., March 2, 1930.

Clytocosmus tillyardi Alexander.

Alexander, Proc. Linn. Soc. N.S.W., 45, 1920, 184–185.—*C. skusei* Alexander, *Rec. S. Aust. Mus.*, 2, 1922, 252–253.—*C. skusei* Alexander, *Ann. Mag. Nat. Hist.*, (9) 9, 1922, 159.—*C. tillyardi* Alexander, *ibid.*, (9) 9, 1922, 160.—*C. skusei* Pierre, Diptera, Tipulidae, Tipulinae, Genera Insectorum, Fasc., 186, 1926, 49.—*C. tillyardi* Pierre, *ibid.*, Fasc., 186, 1926, 49.—*C. skusei* Alexander, Proc. Linn. Soc. N.S.W., 52, 1927, 58, fig. 44 (venation).

Sexes dissimilar in colour, the males having the thoracic pattern (both dorsum and pleura) black and silvery-white, the females with the black colours replaced by orange; abdomen black, variegated with silvery-white spots, the second tergite at base ringed with orange; genital segments of both sexes orange; antennae of both sexes (Plate ii, figs. 6, 7) with seven or eight enlarged segments, in the male the basal ones slightly but distinctly bilobed, in the female more cordiform.

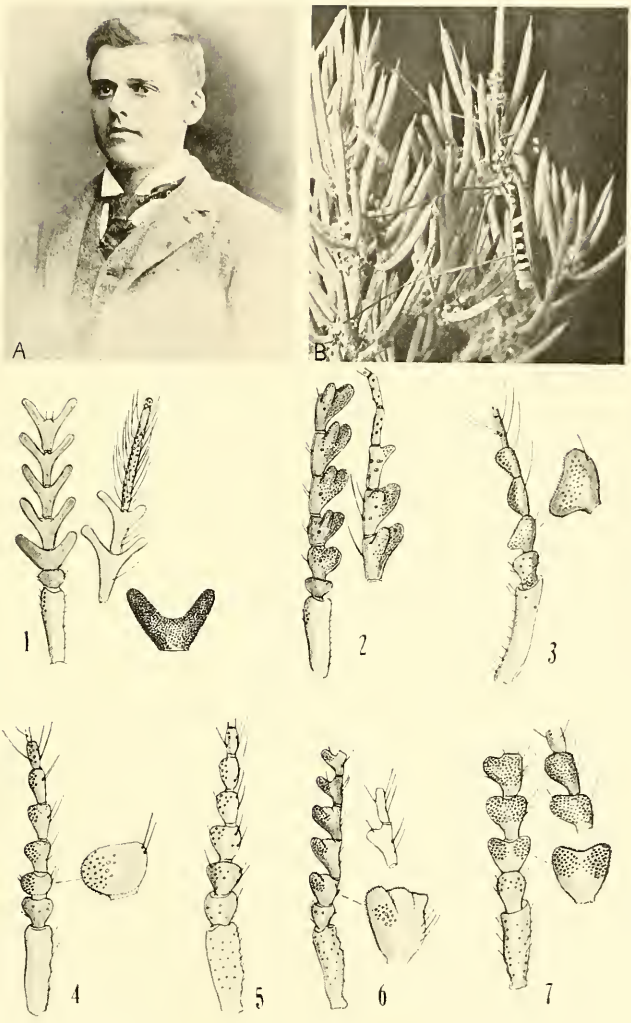
Antennae (male) with seven or eight enlarged flagellar segments, the basal five or six being shortly but distinctly bilobed, the two lobes somewhat unequal, set with transparent punctures; outer enlarged flagellar segments with a single conspicuous lobe, the eighth segment merely enlarged. In the female, flagellar segments one to seven are irregularly cordiform but scarcely bilobed, gradually decreasing in size outwardly and losing the cordiform appearance to a greater or less degree.

As stated before, the black males were earlier characterized by the writer as *Clytocosmus skusei*, the orange females as *C. tillyardi*.

Distribution.—This beautiful species is still known only from the Dorrigo Tableland in north-eastern New South Wales, where it has been taken from April to June, by Mr. William Heron and Dr. Tillyard.

Observations.—The following notes by Mr. Heron are of interest: "But two of the black and orange crane-flies came my way this year. I was always under the impression that they were to be found in April and May, making heavy flight, but on two sunny days I saw them very lively and flying high, one up to fifty feet. Most of them were found resting at considerable heights (about twenty feet) on *Eucalyptus* suckers and were obtainable only with long-handled nets."—W. Heron, in litt., July, 1922.

"First *Clytocosmus tillyardi* of year on April 24th. Met them on slopes of a north-south watercourse; climbed high trees with long pole attached to net but they were too suspicious and frisky. Finally caught several, flying in ones and pairs. They occurred basking high and low on shrubs, close to water."—W. Heron, in litt., April, 1927.



A.—F. A. A. Skuse. B, 1-7.—*Clytocosmus helmsi.*